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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of:
Scott M. Zimmerman, et al.

Docket: OM-1670

Serial Number: 09/808,752

Group Art Unit: 4335

Filed: March 15, 2001

Examiner: Anita K. Alanko

For: POLYIMIDE ADHESION ENHANCEMENT TO POLYIMIDE FILM

AMENDMENT

Commissioner for Patents
P.O. BOX 1450
Alexandria, Virginia 22313-1450

Sir:

In response to the Notice of Non-Compliant Amendment mailed March 18, 2004, and the Office Actions mailed January 29, 2004 and July 31, 2003, please amend the above identified patent application as follows:

In the claims:

1. (Withdrawn and Currently Amended) A process for forming a printed circuit board composite comprising:
 - a) etching at least one surface of a polyimide substrate;
 - b) coating a first polyimide film onto a surface of a metal foil which polyimide film contains from about 5% to about 80% by weight of the film of a filler; and
 - c) laminating the first polyimide film onto the substrate by:
 - i.) laminating the first polyimide film directly onto at least one etched surface of the substrate, or

ii.) laminating the first polyimide film onto at least one etched surface of the substrate via an intermediate ~~second~~ polymeric film; and wherein the resulting printed circuit board composite has a peel strength of at least 4 lbs./inch.

2. (Withdrawn and Currently Amended) The process of claim 1 wherein the first polyimide film is laminated directly onto at least one etched surface of the substrate.

3. (Withdrawn and Currently Amended) The process of claim 1 wherein the first polyimide film is laminated onto at least one etched surface of the substrate via an intermediate ~~second~~ polymeric film.

Claims 4-8 (Previously Canceled).

9. (Withdrawn) The process of claim 1 wherein the metal foil comprises a material selected from the group consisting of copper, zinc, brass, chrome, nickel, aluminum, stainless steel, iron, gold, silver, titanium and combinations and alloys thereof.

10. (Withdrawn) The process of claim 1 wherein the metal foil comprises copper.

11. (Withdrawn and Currently Amended) The process of claim 1 wherein the first polyimide film has a thickness of about 3 μm to about 50 μm .

12. (Withdrawn) The process of claim 1 wherein the metal foil has a thickness of about 3 μm to about 200 μm .

13. (Withdrawn) The process of claim 1 wherein etching step (a) is conducted with an aqueous alkaline solution.

14. (Withdrawn) The process of claim 1 wherein etching step (a) is conducted with an aqueous solution comprising a Group I or Group II hydroxide.

15. (Withdrawn) The process of claim 1 wherein etching step (a) is conducted with an aqueous alkaline solution comprising NaOH or KOH.

16. (Withdrawn) The process of claim 1 wherein etching step (a) is conducted with a plasma etchant.

17. (Withdrawn) The process of claim 1 wherein etching step (a) is conducted with a plasma etchant comprising a mixture of oxygen (O₂) and tetrafluoromethane.

18. (Withdrawn) The process of claim 17 wherein the plasma etchant comprises at least about 3% of tetrafluoromethane.

19. (Withdrawn) The process of claim 17 wherein the plasma etchant comprises greater than about 7% of tetrafluoromethane.

20. (Withdrawn) The process of claim 1 wherein etching step (a) is conducted such that at least about 0.45 μ m of the substrate surface is removed.

21. (Withdrawn and Currently Amended) The process of claim 1 wherein laminating is conducted by autoclave lamination; vacuum hydraulic pressing; non-vacuum hydraulic pressing; hot roll lamination; or by heating the metal foil by an amount sufficient to soften the polymeric polyimide film by flowing an

electric current through the foil and attaching the ~~polymeric~~ polyimide film to the substrate.

22. (Withdrawn and Currently Amended) The process of claim 1 wherein ~~first~~ and ~~second~~ the surfaces of the substrate are etched.

23. (Withdrawn and Currently Amended) The process of claim 22 further comprising:

i.) laminating an additional ~~first~~ polyimide film coated on a surface of an additional metal foil directly onto ~~the~~ a second etched surface of the substrate, which additional polyimide film contains from about 5% to about 80% by weight of the film of a filler, or

ii.) laminating an additional ~~first~~ polyimide film coated on a surface of an additional metal foil onto the second etched surface of the substrate via an intermediate ~~second~~ polymeric film, which additional polyimide film contains from about 5% to about 80% by weight of the film of a filler.

24. (Withdrawn and Currently Amended) The process of claim 23 wherein the additional ~~first~~ polyimide film is laminated directly onto the second etched surface of the substrate.

25. (Withdrawn and Currently Amended) The process of claim 23 wherein the additional ~~first~~ polyimide film is laminated onto the second etched surface of the substrate via an intermediate ~~second~~ polymeric film.

26. (Withdrawn and Currently Amended) The process of claim 23 wherein laminating is conducted by autoclave lamination; vacuum hydraulic pressing; non-vacuum hydraulic pressing; hot roll lamination; or by heating the metal foil by an amount sufficient to soften the ~~polymeric~~ polyimide film by flowing an

electric current through the foil and attaching the ~~polymeric~~ polyimide film to the substrate.

27. (Currently Amended) A printed circuit board composite comprising a polyimide substrate having a first etched surface, a first ~~polyamide~~ polyimide film ~~attached~~ laminated to the first etched surface of the substrate and a layer of a metal foil attached to an opposite side of the first polyimide film which polyimide film contains from about 5% to about 80% by weight of the film of a filler; and wherein the resulting printed circuit board composite has a peel strength of at least 4 lbs./inch.

28. (Currently Amended) The printed circuit board composite of claim 27 wherein the substrate further comprises a second etched surface opposite the first etched surface, an additional ~~first~~ polyimide film ~~attached~~ laminated to the second etched surface and an additional layer of a metal foil attached to an opposite side of the additional first polyimide film, which additional polyimide film contains from about 5% to about 80% by weight of the film of a filler.

Claims 29 and 30 (Previously Canceled).

31. (Original) The printed circuit board composite of claim 27 wherein the metal foil comprises a material selected from the group consisting of copper, zinc, brass, chrome, nickel, aluminum, stainless steel, iron, gold, silver, titanium and combinations and alloys thereof.

32. (Original) The printed circuit board composite of claim 27 wherein the metal foil comprises copper.

33. (Currently Amended) The printed circuit board composite of claim 27 wherein the first ~~polymeric~~ polyimide film has a thickness of from about 3 μm to about 50 μm .

34. (Original) The printed circuit board composite of claim 27 wherein the metal foil has a thickness of from about 3 μm to about 200 μm .

35. (Withdrawn and Currently Amended) A process for forming a printed circuit board comprising:

- a) etching at least one surface of a polyimide substrate;
 - b) coating a first polyimide film onto a surface of a metal foil, which polyimide film contains from about 5% to about 80% by weight of the film of a filler;
 - c) laminating the first polyimide film onto the substrate by:
 - i.) laminating the first polyimide film directly onto at least one etched surface of the substrate, or
 - ii.) laminating the first polyimide film onto at least one etched surface of the substrate via an intermediate ~~second~~ polymeric film;
 - d) depositing a photoresist onto the metal foil;
 - e) imagewise exposing and developing the photoresist, thereby revealing underlying portions of the metal foil; and
 - f) removing the revealed underlying portions of the metal foil; and
- wherein the resulting printed circuit board has a peel strength of at least 4 lbs./inch.

36. (Withdrawn and Currently Amended) The process of claim 35 further comprising roughening the surface of the metal foil opposite the ~~polymeric~~ polyimide film prior to step (d).

37. (Withdrawn) The process of claim 36 wherein the roughened surface of the metal foil has an average roughness value that ranges from about 1 to about 10 microns.

38. (Withdrawn) The process of claim 36 wherein the roughened surface of the metal foil comprises micro-nodules of a metal or metal alloy on or in the roughened surface.

39. (Withdrawn) The process of claim 36 wherein the roughened surface of the metal foil is roughened by micro-etching.

40. (Withdrawn) The process of claim 35 further comprising the step of removing any remaining photoresist after step (f).

41. (Withdrawn) The process of claim 35 wherein the revealed portions of the metal foil are removed by acid etching.

42. (Withdrawn) The process of claim 35 wherein the revealed portions of the metal foil are removed by alkaline etching to the substrate.

43. (Withdrawn) The process of claim 1 wherein the polyimide film is applied to the metal foil by coating a solvent solution of the polyimide onto the foil and drying wherein the solution has a viscosity ranging from about 5,000 to about 35,000 centipoise.

44. (Previously Presented) The printed circuit board composite of claim 27 wherein the polyimide film has been applied to the metal foil by coating a solvent solution of the polyimide onto the foil and drying wherein the solution has a viscosity ranging from about 5,000 to about 35,000 centipoise.

45. (Withdrawn and Previously Presented) The process of claim 35 wherein the polyimide film is applied to the metal foil by coating a solvent solution of the polyimide onto the foil and drying wherein the solution has a viscosity ranging from about 5,000 to about 35,000 centipoise.

46. (New and Withdrawn) The process of claim 1 wherein the filler comprises a material selected from the group consisting of ceramics, boron nitride, silica, barium titanate, strontium titanate, barium strontium titanate, quartz, glass beads, micro-spheres, aluminum oxide, non-ceramic fillers and combinations thereof.

47. 46 (New) The printed circuit board composite of claim 27 wherein the filler comprises a material selected from the group consisting of ceramics, boron nitride, silica, barium titanate, strontium titanate, barium strontium titanate, quartz, glass beads, micro-spheres, aluminum oxide, non-ceramic fillers and combinations thereof.

48. 46. (New and Withdrawn) The process of claim 35 wherein the filler comprises a material selected from the group consisting of ceramics, boron nitride, silica, barium titanate, strontium titanate, barium strontium titanate, quartz, glass beads, micro-spheres, aluminum oxide, non-ceramic fillers and combinations thereof.